

Rocky Mountains north to west winds were most frequently noted. In the middle Atlantic and east Gulf states, the lower Mississippi, Ohio, and Missouri valleys, Tennessee, and the lower lake region they were mostly from the northwest. In the west Gulf states and on the north Pacific coast variable; in the upper lake region, northerly, and in the plateau regions of the Rocky Mountains, and on the immediate Pacific coast south of the fortieth parallel, from southwest to northwest.

HIGH WINDS (in miles per hour).

Maximum velocities of fifty miles, or more, per hour, other than those given in the table of miscellaneous meteorological data, have been reported as follows: Block Island, R. I., 57, ne., 5th; 52, ne., 15th; 60, ne., 17th; 60, ne., 20th; 62, ne., 21st. Hatteras, N. C., 53, n., 15th; 52, n., 28th. Fort Canby, Wash., 50, s., 18th. Tatoosh Island, Wash., 50, e., 7th.

LOCAL STORMS.

The following description of storms generally refer to disturbances which attended the passage of areas of low pressure traced on chart i:

13th. Michigan.—Sault de Ste. Marie: high northwesterly wind began 4.15 a. m.; it attained the velocity of a gale at 7.40 a. m. and continued twelve hours; maximum velocity, thirty-four miles per hour from the northwest; signs were blown down and telegraph and telephone wires were damaged by the wind.

14th. Georgia.—Savannah: light rain fell all day. The wind blew at the rate of about thirty-six miles per hour from the northwest most of the afternoon, and attained a maximum velocity of forty-six miles per hour, blowing down limbs of trees, chimneys, signs, etc.

14th and 15th. Virginia.—Cape Henry: a gale from the northeast began 12.35 p. m., 14th; it increased steadily in force from 2 p. m. through the night and following day, attaining a maximum velocity of seventy-two miles per hour from the northeast on the 15th. The brigantine "Agnes Barton" was blown ashore and wrecked during the storm.

15-16th. Virginia.—Norfolk: a severe storm prevailed. The wind attained its maximum velocity, thirty-five miles per hour, at 12.30 a. m., 15th. A large number of vessels were wrecked or otherwise damaged and several persons were drowned during the gale.

18th. Tennessee.—Dayton: this city was visited in the evening by the heaviest rain and thunder-storm ever known here. The waters of Richland Creek, which runs through the city were so swollen that the fires in the furnaces were put out. A mile and a half of railroad was washed out and great damage done to other property. The loss in this vicinity

is estimated at \$16,000—*The Daily American, Nashville, Tenn., March 20th.* Chattanooga: a thunder-storm began 6.33 p. m. and ended 11.55 p. m.; heavy rain falling for about two hours and light rain continuing until after midnight. The sewers being inadequate to carry off the water, some streets in the city were flooded. Hail occurred for five minutes during the storm, the stones being as large as a medium-sized marble, breaking a number of skylights and window panes.

19th. North Carolina.—Wilmington: the hail and thunder-storm in the evening was very severe in the northern section of the city. At the Wilmington Compress building nearly all the glass in the skylights was broken, and the hail drifted in places to a depth of twelve inches; the hail also caused much damage to plants and shrubbery. Beyond the city limits north and west the storm was still more severe. At Navassa Guano Works one hundred and fifty panes of glass were broken and the drifts were three feet deep.—*The Morning Star, Wilmington, March 21st.*

21st. Texas.—Fort Clark: a terrific hail storm with lightning and high wind passed over this place from the north at 10 p. m.; stones the size of pigeon eggs, and some larger, fell. An enormous quantity of fish, estimated at several wagon loads, were found dead on the banks of Las Moras Creek after the storm. The crops in the company gardens were destroyed.—*Report of United States Army post surgeon.*

30th. Iowa.—Davenport: a severe thunder-storm, accompanied by sharp lightning, hail, heavy rain, and high south-east wind, with a maximum velocity of thirty-two miles per hour, occurred in the afternoon; the wires of the electric light company were shattered by lightning and the light extinguished; the storm also caused a delay of several hours to the electric cars in this city. A furniture factory was struck by lightning and the building set on fire; loss \$20,000.

31st. Kentucky.—Lexington: light rain fell at intervals during the day and a severe gale from the southwest began 11 a. m., attaining a maximum velocity of sixty-two miles per hour, which is the highest wind velocity recorded here since the establishment of the Signal Service station in 1887. **Texas.**—Hico, Hamilton Co: a storm about twenty feet in width, and moving in a northeasterly direction, passed about one mile west of this town between 2 p. m. and 3 p. m. One house in its path was twisted and hurled about, and a rock chimney standing between two rooms fell, killing two children and injuring others. After passing this point the storm disappeared. It is reported that a cloud-burst occurred about two miles northwest of this place a few minutes after the storm had passed, and that about twelve inches of rain fell in a few minutes.—*Reported by Mr. J. C. Rodgers.*

INLAND NAVIGATION.

ICE IN RIVERS AND HARBORS.

Connecticut River.—New London, Conn.: the river was open to navigation on the 6th; it has been one of the shortest ice seasons in the history of the river.—*New London Telegraph, March 6th.*

Hudson River.—Albany, N. Y.: the first boat of the season, from New York City, arrived here on the 21st.

Oswego River.—Oswego, N. Y.: the ice passed out of river very rapidly on the 17th and 18th, and the river and harbor were free of ice on the 19th, but filled up on the following day; it passed out again on the 24th.

Niagara River.—Buffalo, N. Y.: floating ice in river 11th, 13th, 23d, 25th, and floating ice in harbor, 22d, 23d, 25th.

Maumee River.—Toledo, Ohio: the ice in river broke and passed out into the lake on the 12th; the river was nearly free of ice the following day, and open to navigation on the 17th.

Beaver Creek.—Pittsburgh, Pa., 5th: the new bridge across the creek at Fallston, about one mile above Rochester, Pa., is in danger of being carried away by an immense gorge of ice.

The ice has formed a regular dam at the bridge, and every hour tons are being added to the weight.—*New London Telegraph, March 6th.*

Black River.—Port Huron, Mich.: the river was free of ice on the 16th.

Pine River.—Saint Clair, Mich.: the ferryboat "Clara" began her regular trips on the 6th, after having been laid up one month.—*Saint Clair Republican, March 7th.*

Thunder River.—Alpena, Mich.: the river and bay were clear of ice on the 19th.

Saginaw River.—The ice was moving out of the river on the 14th. A narrow bridge of thin ice at the foot of Lake Huron was all the ice perceptible from Fort Gratiot, clear water appearing as far as the eye could reach.—*Buffalo Courier, March 16th.*

Grand River.—Grand Haven, Mich.: the river was almost clear of ice on the 5th, and vessels can now enter and leave the port without difficulty.

Saint Clair River.—Detroit, Mich.: the steamer "R. G. Stew-

art" left here on a trial trip up the river on the 21st, and the steamer "City of Cleveland" cleared for Cleveland, Ohio, on the same day; navigation was fully resumed on the 30th, when the boats began their regular trips. Port Huron, Mich.: the river was clear of ice as far as Algona, Saint Clair Co., Mich., on the 9th; the steamer "Mary," after having been laid up since February 6th, resumed her regular trips between this point and Marine City, Mich., this day. The high wind of the 19th drove a large quantity of ice from Lake Huron up into the river, the ferry-boats with difficulty forcing a passage through the ice at times; the river was also full of floating ice on the 20th and 25th.

Allegheny River.—Pittsburgh, Pa.: floating ice in river 3d to 11th.

Mississippi River.—Davenport, Iowa, 14th: the ferry boat is making regular trips. The steamer "Pilot" came down the river from Princeton, Iowa, this morning, and the steamer "Dick Clyde" left to-day with seven barges for Keokuk, Iowa. Saint Paul, Minn.: the ice dam in river from Robert street bridge down ran out during the afternoon of the 20th; no damage caused. Keokuk: the ice dam in river broke on the 2d. The Warsaw packet "Patience" resumed her regular trips on the 9th, opening navigation. La Crosse, Wis.: the ice moved out in the river, opposite this city, at noon on the 15th. The steamer "Pittsburgh," from Dubuque, Iowa, bound for Winona, Minn., arrived here at 9 a. m. 30th; this was the first arrival of the season. Dubuque, Iowa: the ice in river began to break up on the 11th, and the river was clear of ice at this point on the 12th. Floating ice in river 13th, 14th, and river open to navigation on the 16th.

Missouri River.—Fort Yates, Dak.: floating ice in river 15th and 22d. Fort Buford, Dak.: the ice in river moved out freely from the 21st to the 25th; the river was clear of ice on the 26th. Bismarck, Dak.: the ice in river broke up at 10 a. m. 21st, and run out. Leavenworth, Kans.: the gorge which formed in the river during the night of February 28th and March 1st moved out during the night of the 2d-3d; floating ice in river 3d, 4th. Omaha, Nebr.: the river, which has remained frozen since January 18th, broke the afternoon of the 4th; floating ice in river 5th to 8th. Owing to the low stage of water no damage was done by the moving ice. Kansas City, Mo.: floating ice in river on the 3d and 4th.

Lake Ontario.—Rochester, N. Y.: the lake was clear of ice, as far as the eye could reach, on the 5th.

Lake Erie.—Cleveland, Ohio: the steamer "City of Cleveland" arrived at this port from Detroit, Mich., at 4.30 p. m., 21st; she reports that no obstruction of ice was encountered during her passage.

Sandusky Bay.—Sandusky, Ohio: the bay was clear of ice on the 13th, and navigation on Lake Erie opened for the season.

Presque Isle Bay.—Erie, Pa.: an open space of water was observed to extend out into Lake Erie, as far as the eye could reach, on the 12th.

Black Lake.—Holland, Ottawa Co., Mich., 19th: the ice in the lake was all driven out last night, and navigation is open here two weeks earlier than last year.—*Detroit Free Press*, 20th.

Macinac Straits.—Sheboygan, Wis., 18th: the ice in the north passage is reported broken up to within less than a mile from Macinac Island docks, and boats can now reach the island from Detroit. The ice in this passage is broken up to within three miles of Dummy Light.—*Detroit Free Press*, March 19th.

Lake Michigan.—Milwaukee, Wis., 28th: the harbors on the lake are reported free of ice. A sailing vessel arrived at this port from Kewaunee, Wis., yesterday, being the first sail arrival of the season. The Milwaukee River at this place is entirely free of ice.

Lake Superior.—Duluth, Minn.: the fishing tug "Eviston" left for the south shore on the morning of the 17th and returned in the evening, same day; she found but little difficulty in getting through the ice, which extends about one mile out from the shore in a broken condition. Propeller "Ossifrage" cleared for Grand Marais, Minn., at noon, 25th, and returned

the following day; the captain reports the lake clear of ice as far as can be seen beyond that point.

STAGE OF WATER IN RIVERS AND HARBORS.

In the following table are shown the danger-points at the various stations; the highest and lowest depths for March, 1889, with the dates of occurrence and the monthly ranges:

Heights of rivers above low-water mark, March, 1889 (in feet and tenths).

| Stations. | Danger-point on gauge. | Highest water. | | Lowest water. | | Monthly range. |
|---------------------------|------------------------|----------------|---------|---------------|---------|----------------|
| | | Date. | Height. | Date. | Height. | |
| <i>Red River:</i> | | | | | | |
| Shreveport, La. | 29.9 | 19 | 24.0 | 5, 6 | 19.9 | 4.1 |
| <i>Arkansas River:</i> | | | | | | |
| Fort Smith, Ark. | 22.0 | 26 | 20.0 | 22 | 4.8 | 15.2 |
| Little Rock, Ark. | 23.0 | 28 | 21.5 | 1 | 7.2 | 14.3 |
| <i>Missouri River:</i> | | | | | | |
| Leavenworth, Kans. | 20.0 | 2 | 12.8 | 4 | 5.4 | 7.4 |
| Kansas City, Mo. | 21.0 | 30 | 9.7 | 1 | 5.8 | 3.9 |
| <i>Mississippi River:</i> | | | | | | |
| Saint Paul, Minn. | 14.5 | 24, 25 | 4.2 | 22, 31 | 3.5 | 0.7 |
| La Crosse, Wis. | 24.0 | 16 | 6.0 | 19 | 4.7 | 1.3 |
| Dubuque, Iowa | 16.0 | 31 | 7.3 | 15, 17 | 6.0 | 1.3 |
| Davenport, Iowa | 15.0 | 13 | 6.0 | 16, 18, 19 | 4.5 | 1.5 |
| Keokuk, Iowa | 14.0 | 1 | 9.7 | 6 | 3.0 | 6.7 |
| Saint Louis, Mo. | 32.0 | 5-6 | 16.4 | 1 | 5.3 | 11.1 |
| Cairo, Ill. | 40.0 | 1 | 31.4 | 21 | 20.8 | 10.6 |
| Memphis, Tenn. | 34.0 | 2 | 26.3 | 24 | 16.4 | 9.9 |
| Vicksburg, Miss. | 41.0 | 11, 12 | 33.6 | 28 | 25.5 | 8.1 |
| New Orleans, La. | 13.0 | 18 | 12.7 | 1 | 9.2 | 3.5 |
| <i>Ohio River:</i> | | | | | | |
| Pittsburgh, Pa. | 22.0 | 6 | 13.8 | 1 | 3.6 | 10.2 |
| Parkersburg, W. Va. | 38.0 | 8 | 17.9 | 1 | 6.5 | 11.4 |
| Cincinnati, Ohio | 50.0 | 10 | 28.0 | 3, 18 | 16.0 | 12.0 |
| Louisville, Ky. | 25.0 | 11 | 10.6 | 19 | 7.4 | 3.2 |
| <i>Cumberland River:</i> | | | | | | |
| Nashville, Tenn. | 40.0 | 23 | 21.6 | 18, 19 | 6.3 | 15.3 |
| <i>Tennessee River:</i> | | | | | | |
| Knoxville, Tenn. | 29.0 | 5 | 3.3 | 31 | 1.9 | 1.4 |
| Chattanooga, Tenn. | 33.0 | 22 | 9.5 | 17 | 3.2 | 6.3 |
| <i>Monongahela River:</i> | | | | | | |
| Pittsburgh, Pa. | 29.0 | 6 | 13.8 | 1 | 3.6 | 10.2 |
| <i>Savannah River:</i> | | | | | | |
| Augusta, Ga. | 32.0 | 4 | 21.0 | 24, 31 | 9.9 | 11.1 |
| <i>Willamette River:</i> | | | | | | |
| Portland, Oregon .. | 15.0 | 16 | 4.8 | 6, 7, 8, 9 | 0.8 | 4.0 |

* For 16 days. † For 15 days.

FLOODS.

San Antonio, Tex.: the unusually heavy rain which fell during the morning of the 1st caused some damage to buildings, sidewalks, and culverts in this city; much damage occurred along the banks of the San Antonio River; numerous small bridges, bath houses, fences, etc., were swept away by the rapid rise of the water.

Harrisburg, Pa., 4th: the incessant rain which has been falling since the early morning of the 2d has caused a rise in all streams emptying into the Susquehanna River. The Paxton Creek is overflowing its banks and inundating the low grounds along its course.

Philadelphia, Pa., 5th: the waters of the Delaware and Schuylkill rivers and Wissahickon Creek are much swollen in consequence of the heavy rain storm which began on the evening of the second. At Manayunk the Schuylkill rose fourteen feet above its level and a number of manufactories were compelled to suspend operation. Chambersburg, Pa., 5th: the rain has swollen the streams running through here to a dangerous height. The lowlands on the eastern side of the town are all under water. The track of the Western Maryland Railroad between Chambersburg and Waynesborough is under water for several miles and all trains are delayed.—*New London Telegraph*, March 6th.

Eureka, Humboldt Co., Cal., 14th: the high stage of water in Eel River is causing the banks to be overflowed, doing considerable damage to property in this section.

Los Angeles, Cal., 17th: the heavy rains of the last few days have caused several washouts on the railroads in this section, and all traffic was generally suspended on the 16th. The Los Angeles River did not overflow but is running full, damaging the levee, washing away several timbers in the Downey avenue bridge in this city, and injuring the approaches of the other bridges; many of the streets were badly washed and a great number of cellars flooded.

HIGH TIDES.

Atlantic City, N. J., 16th: it has been many years since the tide has been as high here as to-day. The storm which has prevailed on the coast caused the high water, and for a few hours Atlantic City was cut off westward by the flooding of the railroad tracks which cross the meadows. The water on the Camden and Atlantic Railroad this morning was so high that the fires in the railroad engines were extinguished. This afternoon the Five-Mile Beach branch railroad is under water and the Sea Isle City and Ocean City branch is flooded. No trains are running beyond Sea Isle City. Cape May, 16th: the tide is the highest known for years; much damage has been done here.—*Buffalo Express*, March 17th.

Long Branch, N. J., 16th: the severe storm and high tides which have prevailed along the coast for the past twenty-four hours have caused a great amount of damage. The tide in the Shrewsbury River ran higher than in many years. Sea Bright, N. J., 16th: at high tide to-night the heavy sea broke over the beach and is now sweeping through the hollow almost in the center of the town. The piles of lumber from bulkheads have been carried to Ocean avenue, striking the fishermen's huts in the hollow and demolishing them. The water in some streets is three feet deep and running with great force.—*Baltimore Sun*, March 17th.

Asbury Park, N. J., 17th: the high tides of last night and this morning were very destructive along this part of the coast; the great board walk here was severely damaged, and the bluff was washed out in several places. At Elberon several bulkheads were washed out. Point Pleasant, March 17th: at Bay Head bulkheads were washed away. In many places the surf ran over the beaches and did much damage. The railroad tracks from Absecon to Atlantic City were under water, and no train could cross at high tide. All the lowlands are over-

flooded. The railroad from Atlantic City to Egg Harbor Inlet is broken up and trains cannot run. The railroad from Ocean City to the mainland was under water, as was the railroad from Sea Isle to Avelon.—*The New York Sun*, March 18th.

Norfolk, Va.: an unusually high tide occurred on the 15th and 20th, flooding the lower portions of the city; during the first named date all street car travel was interrupted during the day by the high water. Atlantic City, N. J.: an unprecedented high tide occurred here on the 20th; it was very destructive to the board walk, bath-houses, pavilions, and even many of the larger houses. Building after building was quickly undermined by the rushing water and tumbled down into the sea. All along the beach is strewn debris.—*The York World*, March 22d.

New York City: it is reported that the tide at Coney Island on the morning of the 21st was the highest of the season; the whole distance in and about the bulkhead is a wreck, which \$100,000 will not make good.—*The New York World*, March 22d. A big tide prevailed on the 21st in the lower part of Elizabeth, N. J., and several of the lower stories of houses near the meadows were flooded. Communication with the factories along Staten Island Sound was completely cut off at high water. The tracks of the Newark and Elizabeth branch of the Central Railroad were flooded in places to the depth of nearly five inches, as also were the tracks of the Long Branch Railroad. The tide at South Beach, Staten Island, was the highest seen in many years and did considerable damage. The sea at 11 a. m. broke over the embankments and flooded the swamp for several miles.—*New York Daily Tribune*, March 22d.

High tides also occurred as follows: Eastport, Me., 21st; Wood's Holl, Mass., 16th; Cape Henry, Va., 14th, 15th, 19th, 20th.

ATMOSPHERIC ELECTRICITY.

AURORAS.

Auroral displays were noted on the 5th at stations in Michigan, Illinois, Iowa, Minnesota, Dakota, and Montana; on the 28th in northern Ohio, western New York, Minnesota, and Dakota, and on the 27th in southwestern Michigan, northern Illinois, and eastern Minnesota. No auroras were reported at stations south of the fortieth parallel or east of the seventy-seventh meridian. The following are descriptions of the more notable displays observed:

Bismarck, Dak.: an auroral arch of pale yellow color, with a dark segment beneath, and extending from azimuth 135° to 225° and to altitude 30°, was first observed 9.15 p. m., 5th. Its maximum intensity occurred at 11.30 p. m., and the display ended during the night.

Moorhead, Minn.: an aurora was observed 10.30 p. m., 5th. It consisted of a steady white arch which extended from azimuth 160° to 235°, and rose to altitude 30°. The display continued as described until daylight of the 6th. Another auroral display, consisting of a pale white arch, was observed from 3.30 a. m. until daylight on the 28th.

Fort Buford, Dak.: an auroral display was observed 10.18 p. m., 5th. It consisted of a faint yellowish light in the form of an arch which rose gradually until it attained altitude 40°, at 11.05 p. m. No change in color or brilliancy occurred during its rise, but a second partial arch formed which was only slightly visible at some points; it had an altitude of about 30°. The aurora had entirely disappeared at 1.50 a. m., 6th.

Duluth, Minn.: an aurora was first observed 9.15 p. m., 5th, consisting of an irregular whitish light extending from azimuth 170° to 210° and to altitude about 30°. At 9.50 p. m. it changed to a pale yellow arch, from which occasional streamers moved from east to west, and occupied the same position in azimuth and altitude 10°, beneath which the dark segment was well defined. The sky became obscured 11.15 p. m.

Another auroral display was observed 10.15 p. m., 27th, consisting of a pale light extending over the northern sky from about azimuth 180° to 220°, and rising to altitude 20°. At 11.30 p. m. it assumed a pale yellow tint, and rested upon an irregular arch, from which bright streamers rose to altitude 45°. The display continued until after midnight but no new features were observed.

Saint Vincent, Minn.: an auroral light was observed 9.15 p. m., 6th, and ended during the night. It consisted of a confused mass of whitish light, at times developing into a more or less distinct arch, which covered 130° of the horizon, and reached altitude 15°. Its maximum brilliancy occurred 12.30 a. m., 7th, at which time several "needles" appeared rising from the arch to altitude 40°.

Fort Buford, Dak.: an aurora was first observed 12.22 a. m., 28th. It consisted of an arch of whitish color which extended over 90° of the horizon between northwest and northeast, and rising gradually to altitude about 40°, when it became stationary, and slightly increased in brilliancy. A second arch formed about the time the first one reached its maximum intensity; this arch rose to altitude 60°, and its most brilliant part was the centre. The display ended 2.45 p. m.

Auroras were observed during the month as follows: 1st, Bismarck, Dak.; Gillett, Iowa. 2d, Dunkerton, Iowa. 3d, Saint Vincent, Minn. 5th, Bismarck, Fort Buford, Fort Sully, Kimball, Webster, Wolsey, and Woonsocket, Dak.; Cedarville, and Riley, Ill.; Ames, Amana, Cresco, Dysart, Gillett, Independence, Monticello, and Osage, Iowa; Pontiac and Traverse City, Mich.; Duluth and Moorhead, Minn.; Fort Assinaboine, Mont.; Embarrass, Wis. 6th, Saint Vincent, Minn.; Fort Assinaboine, Mont. 14th, Hess Road Station, Mich. 19th, Fort Sully, Dak.; Saint Vincent, Minn. 21st, Milwaukee, Wis. 24th, Saint Vincent, Minn. 27th, Mount Morris, Ill.; Berrien Springs, Mich.; Duluth, Minn. 28th,